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REA MODEL - ANALYSIS AND DEVELOPMENT OF AN INTER-ENTERPRISE ACCOUNTING INFORMATION SYSTEM IN THE GLOBAL ENVIRONMENT

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Abstract

The motivation of this study is to provide students with insight into REA and UML used in developing and implementing an inter-enterprise accounting information system in the global environment. This study focuses on preparing an overview and detailed activity diagrams, workflow table model and REA (Resource, Event, Agent) model. The analysis of the business process is also prepared. This study is to analyze the activities of business processes and their relationship to costs and to times. The findings in this research provide a descriptive analysis and Pearson chi-square test. The results indicate that the more steps and the more complex the events, there is neither more nor less time spent and that this is also true of costs. A limitation of this study is that it focuses only on the expenditure cycle and the sample size of data is too small. Future research should be aimed at the revenue cycle.

Keywords: REA model**;** analysis and development; inter-enterprise AIS; global environment

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Abstract

The motivation of this study is to provide students with insight into REA and UML used in developing and implementing an inter-enterprise accounting information system in the global environment. This study focuses on preparing an overview and detailed activity diagrams, workflow table model and REA (Resource, Event, Agent) model. The analysis of the business process is also prepared. This study is to analyze the activities of business processes and their relationship to costs and to times. The findings in this research provide a descriptive analysis and Pearson chi-square test. The results indicate that the more steps and the more complex the events, there is neither more nor less time spent and that this is also true of costs. A limitation of this study is that it focuses only on the expenditure cycle and the sample size of data is too small. Future research should be aimed at the revenue cycle.

Keywords: REA model**;** analysis and development; inter-enterprise AIS; global environment

1.0 Introduction

In this study, I do make a further development of my prior research entitled "An Analysis and Development of an Inter-enterprise Accounting Information System in the Global Environment." By adding the REA model to my prior research, both REA and UML can be used to model AIS in this research.

This study follows the REA model, an innovative approach to teaching information systems, developed by Bill McCarthy of Michigan State University. The REA model is the framework for analyzing the relationship between an organization's critical Resources, Events, and Agents. Students will benefit from this theoretical foundation for enterprise systems because it provides a glimpse of what is possible in enterprise systems yet also permits comparison to existing systems. This study encourages

students to apply the object patterns (things and relationships between them) and scrip patterns (logical sequences of events) that make up the REA enterprise ontology to help them understand enterprises and transaction cycles/business processes (Dunn et al. 2005).

The purpose of this study is to analyze and develop a strong conceptual foundation of an inter-enterprise accounting information system in the global environment. The major goals of this study are also to provide a strong conceptual foundation in accounting systems and controls, enable students to use this foundation in developing and evaluating accounting applications and in problem-solving, and, present information in a way that facilitates student learning. The ability to visualize a complex business process in terms of events helps student learn and integrate the material provided in class (Rama and Jones 2006).

The researcher uses business processes and events as a basis for developing the conceptual foundation. The purpose of an AIS is to provide information to support and control the underlying business process. Because understanding a process is not always easy, students are provided with a method for partitioning a process into events. Event partitioning is used extensively in AIS, and in understanding accounting applications and transaction cycles. The researcher believes that an introduction to these topics is important and will help students better understand the nature of the accountant's roles of user, designer, and evaluator of accounting systems. Through this study, the researcher expands students' understanding of business processes, AIS applications, risks, and controls in the area of IT, managing and controlling the use of these technologies, and systems development (Rama and Jones 2006). In this study, research focuses on the UML activity diagram which plays the role of a map in understanding business processes by showing the sequence of activities in the process. REA and UML can be used to model AIS. Again, the researcher's focus is on helping students understand the relationship of components in the organization such as resources, events, agents/actors, documents, and files (Rama and Jones 2006). This study focuses on understanding and preparing the overview and detailed activity diagrams, the workflow table model and the REA model of an inter-enterprise accounting information system in the global environment (Gerard 2005).

The primary purpose of this study is also to analyze the relationship between the activities of business processes to costs and times. All data were captured from 40 entrepreneurs in the expenditure cycle: purchasing and cash disbursements (Romney and Steinbart 2006).

The findings in this research provide a descriptive analysis of key information related to the respondents across their background and job functions: company size, position, experience, and education. In this study, events, times and costs were examined based on frequency, percentage, relationship, and agreement of respondents on the impacts of the occurrence of an event to time and cost. The results indicate that the greater the amount of steps and the more complex the events does not result in any more necessary time or more costs than those events which involve less steps and which are less complex.

Students can easily understand how to develop the new information system by using UML as tool. Overview and detailed activity diagrams and REA model were prepared to be used to teach students in classroom. After that, students can solve the project problems given in class. A limitation of this study is the business processes. In this study, the focus is only on the procurement and purchasing systems from globalization. The sample size of data is too small because most entrepreneurs did not give feedback to the e-mails and just keep their data secret such as costs spent on each event. Future research will look at the sale and revenue systems.

2.0 Literature Review, Theory, Research Model, And Hypotheses Development

McCarthy proposed a generalized model for accounting systems after analyzing many accounting transactions and identifying the common features of the transactions. McCarthy and Geerts have further developed the constructs of the original model to form an enterprise domain ontology. This ontology is called the REA Enterprise Ontology because three of the principle constructs are Resources,

Events and Agents. Entity-relationship modeling has been the most commonly used tool for presenting REA business process level patterns. (Dunn et al. 2005).

Business process is a sequence of activities performed by a business for acquiring, producing, and selling goods and services. Accountants and others have an interest in modeling business processes and several models have been developed. Accountants find it useful to view a company's business processes in terms of its transaction cycles, which group related events that typically occur in a particular sequence. Events are activities that happen at a particular point in time (Rama and Jones 2006). Borthick, and Jones (2007) suggest in their work "Creating a business process diagram and database queries to detect billing errors and analyze calling patterns for cell phone service" that in this case, students develop a business process diagram to understand the business situation and create database queries to detect billing discrepancies and to manage the costs for corporate cell phone service.

Bradford, Richtermeyer, and Roberts (2007) assert in "System Diagramming techniques: an analysis of methods used in accounting education and practice" that system diagrams (SD) are an integral component of system documentation and have become increasingly important in response to heightened awareness surrounding process improvement and documentation. The SD included in this study is Unified Modeling Language (UML). This study can be useful to accounting educators by providing insight into SD use in practice. Church, and Smith (2007) propose in "An extension of the REA framework to support balance scorecard information requirements" extensions to the REA framework to encompass the information requirements of the balanced scorecard and other management systems that incorporate non-financial measures. The REA conceptual accounting framework was designed to describe the information architecture related to an organization's economic activity (e.g., McCarthy 1982; Dunn et al. 2005). Gerard (2005) uses the REA pattern as an example of a domain-specific pattern that can be encoded as a knowledge structure for the conceptual modeling of AIS, and tests its effects on the accuracy of conceptual modeling in a familiar business setting. Results suggest it is insufficient to know only conceptual modeling notation because structured knowledge of domain-specific patterns reduces design errors.

Bradford and Fisher (2005) conclude that the case illustrates the complexities of legacy system migration under legal constraints. Systems issues include organizational approaches to systems implementation and business process analysis. This case is appropriate for use in either an undergraduate or graduate AIS course and offers a flexible approach to adoption, ranging from comprehensive adoption of all topics in both parts to specific topics within either part. Verdaasdonk, (2003) suggests in "An object-oriented model for E*x Ante* accounting information" that present accounting data models such as the REA model merely focus on the modeling of static accounting phenomena. A new object-oriented model is presented that enables the use of *ex ante* accounting data for this purpose. In "PMB investments: an enterprise system implementation" (2003) Bagranoff and Brewer describe the implementation of an enterprise information system at the printed materials division of a multinational investment company. There are several issues in the implementation that are worthy of class discussion and include enterprise system implementation rationale and investment justification, software and consultant selection, business process reengineering, change and project management, and evaluation of enterprise system success.

Ingram and Lunsford (2003) highlight in "Developing an e-commerce system using active server pages" a case to illustrate analysis, design, and implementation issues involving a multi-tier e-commerce system. This system is designed for use in advanced accounting systems or systems analysis and design courses and involves analysis of the sales order system that will be implemented using a web interface and relational database, conceptual design of the system, and implementation of the system. Geerts and McCarthy (2006) put forward the REA enterprise model as a widely accepted framework for the design of the accountability infrastructure of enterprise information systems. In "Using a web-based accounting system for teaching accounting system design and implementation" (2006), Lin and Smith help students learn accounting systems from the enterprise perspective instead of the piecemeal account approach. Results indicate that students significantly improve their knowledge and skills regarding systems design and implementation. Normand and Sinason (2006) indicate in "Omni furniture company: a systems development life cycle case" that the system was created to help students enrolled in an AIS course to

further their understanding of the systems development life cycle (SDLC) by thinking through all the stages of the development process.

Based on an in-depth field study of a pilot test of an e-Procurement system, "Accountants and emerging technologies: a case study at the United States Department of The Treasury Bureau of Engraving and Printing" (2006), Gelinas and Gogan introduce the topic of the accountant's role in emerging technology assessments, and present a teaching case for use in an AIS class. In "Caroline's candy shop: an in-class role-play of the revenue cycle" (2005), Hayes and Reynolds regard Bain et al. (2002) as having emphasized the critical importance of the transaction processing cycles and internal control topics to undergraduates on an AIS course. This current article outlines an in-class, role-play exercise designed to provide students with a working understanding of the revenue cycle and its related key documents.

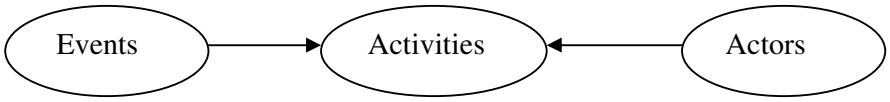
Several techniques are available for documenting business processes. In this study follows the REA model, an innovative approach to teaching information systems, developed by Bill McCarthy of Michigan State University. The REA model is the framework for analyzing the relationship between an organization's critical Resources, Events, and Agents. This study encourages students to apply the object patterns (things and relationships between them) and scrip patterns (logical sequences of events) that make up the REA enterprise ontology to help them understand enterprises and transaction cycles/business processes (Dunn et al. 2005).

In this study, the researcher also uses UML, a language used for specifying, visualizing, constructing, and documenting an information system. UML was developed as a tool for object-oriented analysis and designed by Grady Booch, Jim Rumbaugh, and Ivar Jacobson. It provides an inventory of diagrams for documenting business processes and information systems (Rama and Jones 2006). In this study, the research focuses on the UML activity diagram which plays the role of a map in understanding business processes by showing the sequence of activities in the process. This study also organizes activity diagrams into two types: the overview diagram and the detailed diagram. The overview diagram presents a high-level view of business processes by documenting the key events, the sequence of these events, and the information flows among these events while the detailed diagram provides a more

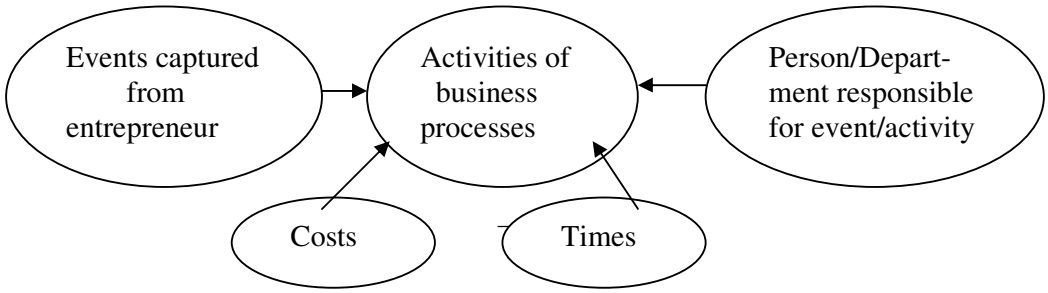
detailed representation of the activities associated with one or two events shown on the overview diagram. The researcher organizes activity diagrams into overview and detailed diagrams as this approach has been found to be useful in documenting and analyzing internal control. In this study, the focus is placed on both of them. UML can be used to model AIS. Again, the researcher's focus is on helping students understand the relationship of components in the organization such as resources, events, agents/actors, documents, and files (Rama and Jones 2006).

This study also examines the understanding and preparing of an overview and detailed activity diagrams and REA diagrams. Figure1a shows the workflow table model conceptual foundation (Rama and Jones 2006). Activities are the function of events and actors. Figure 1b shows this study's workflow table model of an inter-enterprise accounting information system in the global environment (Gerard 2005).

The primary purpose of this study is to analyze the relationship between the activities of business processes to costs and to time - that if activities consist of a greater number of and more complex steps, they will involve higher costs and longer time than activities with less complex and less steps.



a) Workflow Table Model Conceptual Foundation (Rama and Jones 2006)



b) Workflow Table Model of an Inter-Enterprise Accounting Information System in the Global Environment (operation) (Gerard 2005)

Figure 1. Workflow Table Model Conceptual Foundation (Rama and Jones 2006) and Workflow Table Model of an Inter-Enterprise Accounting Information System in the Global Environment (Gerard 2005).

Therefore, the following hypotheses are developed:

Hypothesis 1: There will be a positive relationship between the occurrences of events/activities and times.

Ho: The occurrences of events/activities and times are independent.
Ha: The occurrences of events/activities and times are dependent.

Hypothesis 2: There will be a positive relationship between the occurrences of events/activities and costs.

Ho: The occurrences of events/activities and costs are independent.
Ha: The occurrences of events/activities and costs are dependent.

3.0 Methodology And Sample Selection

In this research, respondents comprised industrial entrepreneurs. Respondents were asked for the steps and flow of purchasing processes among organizations in the global environment (Romney and Steinbart 2006). Table 1 shows the descriptive statistics of key information related to these respondents from the survey. Data from Table 1 indicates that the respondents were purchasing managers and most had a masters and bachelors in accounting as well as more than 20 years of total work experience.

Panel A: Number of Employee	Percentage
0 - 100	5
101 - 300	15
301 - 500	25
501 - 3000	50
Over 3000	5
Panel B: Managerial position	
Inventory	10
Purchasing	50
Receiving	10
Account Payable	5
Finance	10
Accounting	5
CIO	5
CEO	5
Panel C: Years of total work experience	
Less than 3 years	15
3 - 5	10
6 - 10	10
11 - 15	10
16 - 20	15
21 - 25	35
Greater than 25 years	5
Panel D: Education	
< Bachelors in Accounting	10
Bachelors in Accounting	30
Bachelors in Business Administration	10
Masters in Accounting	40
Masters in Business Administration	10

Table 1. Survey of Respondents

Table 2 shows all the data that is organized according to the events in the business processes that were identified. It provides an example of information request for the times and costs of each event and activity.

To begin with, five entrepreneurs participated in pretests. With requested information on times and costs, a workflow table was, therefore, designed with events consisting of activities. This study follows the workflow table showing the conceptual foundation of events and activities composed in a company's business processes in Table 2a (Rama and Jones 2006). Then, the workflow table of an inter-enterprise

accounting information system in the global environment in Table 2b was prepared following the conceptual foundation of events and activities in Table 2a. Table 2b focuses on the events, activities, actors, times, and costs in the trading systems. In designing the workflow table of an inter-enterprise accounting information system in the global environment in Table 2b, the researcher captured all the data/information from prior research, literature, journals and articles, etc. This model is used as the pretest for the five entrepreneurs. The completed model had, then, been established and used in this study. 100 completed models were attached via e-mail to 100 entrepreneurs and 40 models were returned.

Events	Activities	Actors
Event 1	Activity 1.1	Actor 1

	Activity 1.n	
Event 2	Activity 2.1	Actor 2

	Activity 2.n	
----------	----------	
Event n	Activity n.1	Actor n

	Activity n. n	

a) Workflow Table showing The Conceptual Foundation of Events and Activities (Rama and Jones 2006)

Events	Activities	Actors	Times	Costs
Negotiation of contact	Contact vendor	Customer		
	Ask for letter of credit			
Confirmation of schedule	Receive details of products	Customer		
	Examine schedule			
	Receive document/schedule			
Confirmation of credit, payment	Ship cargo to customer	Shipping		
	Pay to Port	Customer		
	Pick up cargo	Carrier		
	Examine documents	Port		
	Prepare truck for cargo			
	Examine cargo			
	Carry cargo on truck			
	Enter sub gate out			
	Enter main gate			
At Port	Transfer cargo from carrier	Port		

	Pay for service to shipping	Customer		
	Examine cargo	Port		
	Enter gate in			
	Transfer cargo on truck			
	Enter gate out			
Cargo shipment	Cargo shipment from port	Customer		
	Prepare cargo for authorization			
	Prepare cargo for investigation			
	Investigation cargo			
	Transfer cargo to warehouse			
Customer procedure	Prepare inspection sheet	Customer		
	Pay for insurance			
	Pass I/S to customs			

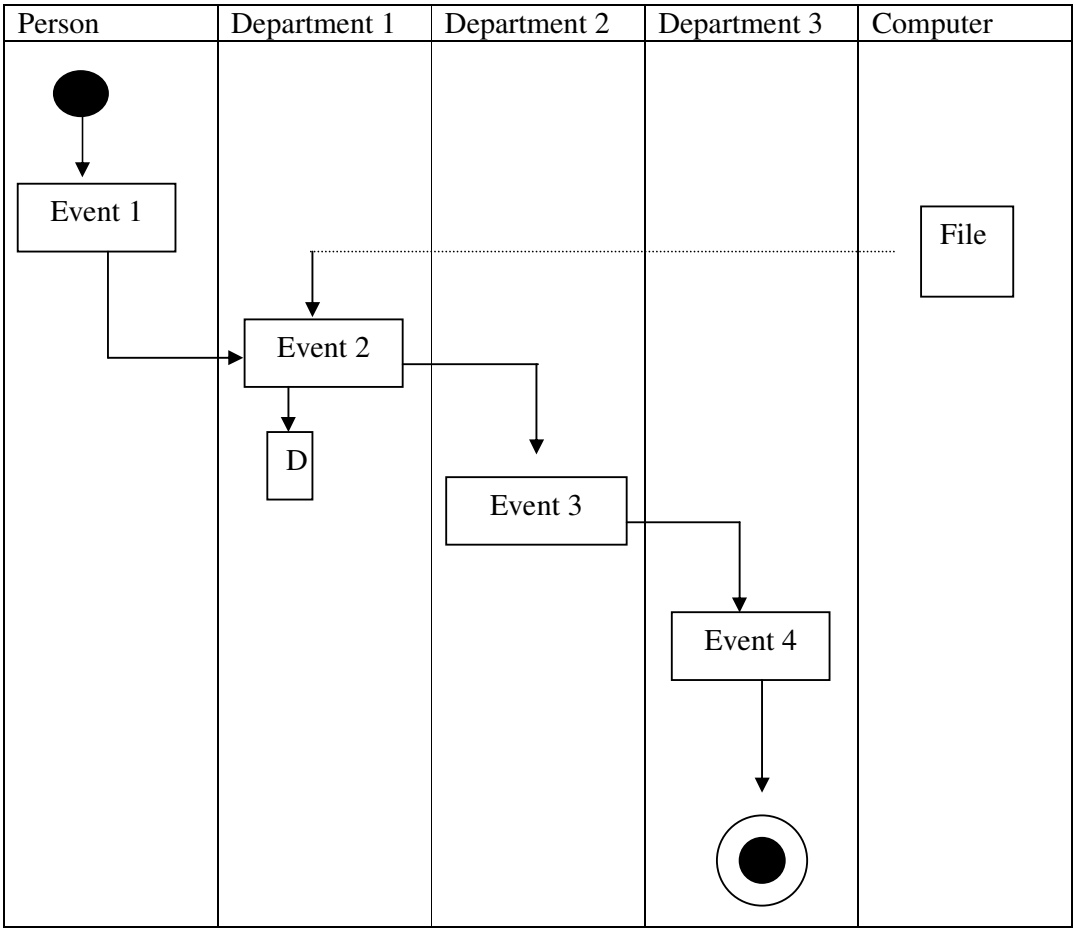
b) Examples of Workflow Table showing an Inter-enterprise Accounting Information System in the Global Environment (Rama and Jones 2006)

Table 2. Workflow Table showing The Conceptual Foundation of Events and Activities composed in a Company's Business Process and an Example of an Inter-enterprise Accounting Information System in the Global Environment (Rama and Jones 2006).

An overview and detailed activity diagram was prepared and used to present a high and detailed level view of business processes by documenting the key events, the sequence of events, and information flow among events. Accountants also have to consider the detailed activities in each event. Detailed activity diagrams show information about the activities in specific events. In order to prepare detailed activity diagrams, we need to recognize the individual activities within each event (Rama and Jones 2006). Figure 2 is an example of a conceptual foundation of an overview/activity diagram created following the descriptions in Table 2a (Rama and Jones 2006). The overview/detailed activity diagram is used as a tool in presenting the flow of events and activities carried out by an actor (Rama and Jones 2006) (see Figure 2a).

Figure 3 shows the overview/detailed activity diagrams of an inter-enterprise accounting information system in the global environment created following the descriptions in Table 2b (Rama and Jones 2006). Figure 4 shows the REA diagrams of an inter-enterprise accounting information system in the global environment presenting the relationship of resources, events, and agents. These diagrams will be

more useful used as tools to teach students in an AIS development and implementation class. Students will be asked to develop and implement the AIS projects. So these diagrams will help them to understand more easily how to prepare their projects (see Figure 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6 and Figure 4.1, 4.2, 4.3, 4.4, 4.5, and 4.6).



a) Conceptual Foundation of an overview activity diagram model (Rama and Jones 2006).

Figure 2. Overview activity diagram model (Rama and Jones 2006)

4.0 Results

4.1 Analysis Of Business Process

Figure 3.1-3.6 displays the overview activity diagrams presenting the flows of business processes and events/activities with data according to the times and costs spent on each event/activity. From the results of the analysis, respondents indicate that the maximum and minimum times spent on activities are 1 month and 1 hour simultaneously. While the maximum and minimum costs spent on activities are $71 and $30 respectively. The negotiation of a contacts event will consume more time and a cargo shipment event will involve greater costs while the cargo shipment event will consume less time and the negotiation of the contacts event will involve lower costs. From these results, respondents indicate that the activities which consume more time and greater costs are activities that are still based on a manual system instead of an IT-based system. To solve these problems, an IT-based new system should be developed and IT-based accounting information systems should be prepared. Communication among actors should be on-line so the cycle steps, cycle times, and cycle costs of business processes can be reduced. Companies can save costs and time in their business processes. Figure 3 shows the overview activity diagrams presenting the flow of events, documents, and files. Figure 4 shows the REA diagrams presenting the relationship of resources, events, and agents.

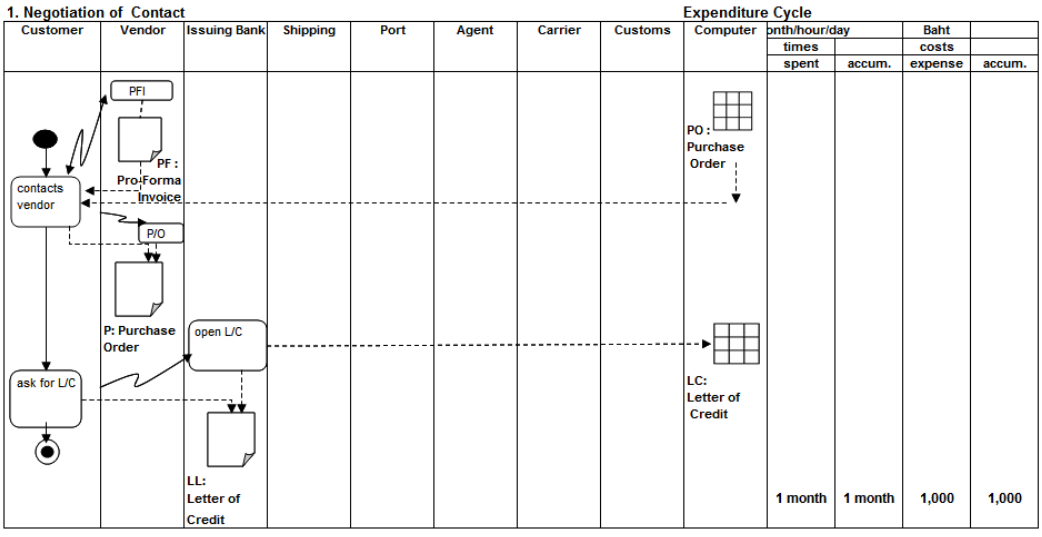
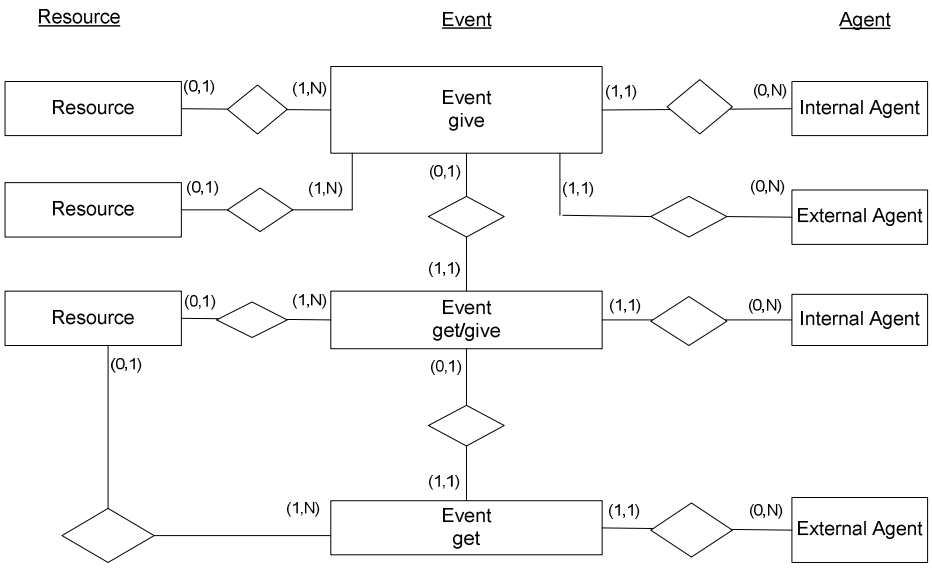


Figure 3. Overview Activity Diagram of an Inter-enterprise Accounting Information System in the Global Environment (3.1)

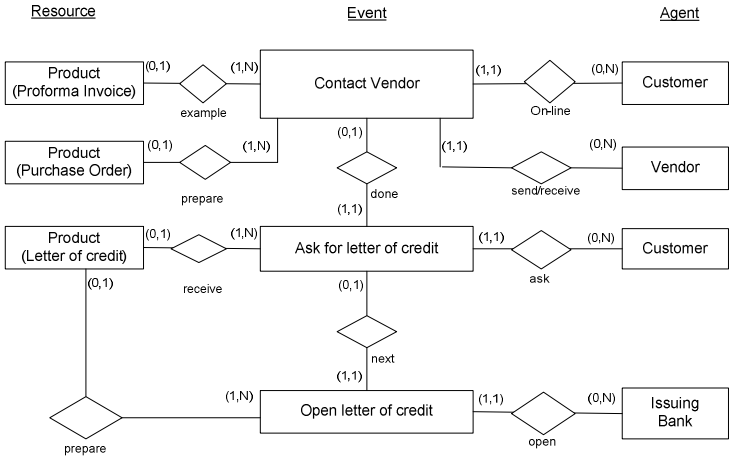


a) General REA Pattern showing Resources, Events, Agents, and relationships (Gerard 2005)

Figure 4

E-R with REA Diagram of an inter-enterprise Accounting Information System in the Global Environment

1. Negotiation of contract



b) **E-R with REA Diagrams of an Inter-Enterprise Accounting Information System in the Global Environment**

Figure 4. General REA Pattern (Gerard 2005), and E-R with REA Diagram of an Inter-Enterprise Accounting Information System in the Global Environment

4.2 Analysis Of Times And Costs

The two hypotheses are tested by examining the expected positive impact of activities on both times (H1) and costs (H2). Results of the analysis are shown in Table 3. While H1 is significant, it should be noted that the times are not aligned to the occurrences of events/activities. Similarly, H2 is also proven to be significant too. Costs are not aligned to the occurrences of events/activities. Table 3 shows the percentage of time on an occurrence of an event/activity while Table 4 shows the percentage of costs on an occurrence of an event/activity. Data from Table 3 and Table 4 indicate that the time spent on an occurrence of an event/activity is greater than $70 and less than or equal to $30 while the cost spent on an occurrence of an event/activity is greater than 1 month and less than or equal to 1 day. Table 5 shows the percentage of agreement of respondents on the impacts of the occurrence of an event/activity to time and cost. This data indicates that most respondents do not agree that the occurrence of each event/activity will affect the amount of time and the costs spent on it. Table 6 indicates that it is not necessary to spend much time on events with many steps and which are more complex while the same is true of events with less steps and which are less complex (Pearson chi-square test was used to analyze data (see Table 8)). A relationship is also found between the events and costs. Table 7 also indicates that events with many and more complex steps do not need to involve much cost with the same being found for events with less and less complex steps (Pearson chi-square test was used to analyze data (see Table 9)). Overall, the results indicate that no relationships were found between the occurrence of events to times and costs. The greater the amount of steps and the more complex the events does not mean more time and more costs than those events which involve less steps and which are less complex.

Time spent	Percentage
0- 1 minute	5
2 - 60 (1 hour)	10
2 - 24 (1 day)	35
2 - 30 (1 month)	5
1 month +	45

Table 3. Percentage of time on an Occurrence of an Event/Activity

Cost spent	Percentage
0 - 100	5
101 - 500	5
501 - 1,000	10
1,001 - 2,000	35
2,000 +	45

Table 4. Percentage of cost on an Occurrence of an Event/Activity

	Time Percentage	Cost Percentage
Agree (Yes)	15.6	10.5
Do not agree (No)	84.4	89.5

Table 5. Percentage of Agreement of Respondents on the Impacts of Occurrence of Event to Time and Cost.

Time / Events	n	very much	much	neither much nor less	less	a lot less
Many steps	40	3	5	31	1	0
Less steps	40	0	0	30	6	4

Table 6. Relationship Between the Occurrence of Events and Times

Time / Events	n	very much	much	neither much nor less	less	a lot less
Many steps	40	3	5	31	1	0
Less steps	40	0	0	30	6	4

Table 7. Relationship Between the Occurrence of Events and Costs

5.0 Conclusions, Limitation And Future Research

UML is a tool used to present the flow of systems developed and implemented in an organization (Rama and Jones 2006). This study provides students with insight into UML used in developing and implementing an AIS. The results of this survey indicate that UML is still being used by accounting students and/or accountants in developing new global information systems. Accounting educators should find these results useful as they present UML in the classrooms. This study focuses on preparing an

overview and detailed activity diagrams, the workflow table model and the REA model. Business processes are analyzed**.** The results indicate that the activity which involves much time and cost is the activity that is still based on a manual system instead of an IT-based system. To solve these problems, an IT-based inter-enterprise accounting information systems in the global environment should be prepared. Communication among actors should be on-line so the cycle steps, cycle times, and cycle costs of business processes can be reduced. Companies can save costs and time in their business processes.

In analysis of time and costs, the primary purpose of this study is to analyze the relationship between the activities of business processes to costs and the activities of business processes to time. The findings in this research provide a descriptive analysis of key information related to the respondents across their background and job functions: company size, position, experience, and education. In this study, events, times and costs were examined based on frequency, percentage, relationship, and agreement of respondents on the impacts of the occurrence of an event to time and cost. The results indicate that the greater the amount of steps and the more complex the events does not result in any more necessary time or more costs than those events which involve less steps and which are less complex.

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